

Variation

INVESTIGATION: Consider the formula $y = 3x$. What value never changes?

This means that y is in proportion to the value of x , that is, y is always triple x .

So we could write $y = 3x$ as $y \propto x$

where \propto means "is in proportion to" and simply means that there is a constant value multiplying x (in this case, 3).

The constant of variation (in this case, 3) is also the gradient of the straight line graph that represents the relationship between the two quantities.

That sign means "is in proportion to"

$y \propto x$

You simply replace it with " $= kx$ "

$$y \propto x$$

$$y = kx$$

Consider the formula for the area of a circle. What value never changes?

This means that the Area is in proportion with the square of the radius.

So we could write $A = \pi r^2$ as _____

$$A = \pi r^2$$

$$k = \pi$$

$$A \propto r^2$$

$$= kx$$



To solve direct variation questions:

1. Replace the \propto sign with " $= kx$ ";
 2. Substitute all known values and solve for k ;
 3. Rewrite the original equation with the value of k subbed;
- Now answer the question!

eg If y varies directly as x and $y = 8$ when $x = 12$, find k and write an equation that expresses this variation.

$$y \propto x$$

$$y = kx$$

$$8 = k \times 12 \div 12$$

$$\frac{8}{12} = k$$

$$\therefore y = \frac{2}{3}x$$

eg If y varies directly as x and $y = 24$ when $x = 16$, find y when $x = 12$.

$$y \propto x$$

$$y = kx$$

$$24 = k \times 16 \div 16$$

$$\frac{24}{16} = k$$

$$y = \frac{3}{2}x$$

$$y = \frac{3}{2} \times 12$$

$$= 18$$

eg If t varies directly as the cube of w , and $t = 1728$ when $w = 6$, find the value of t when $w = 4.5$.

$$t \propto w^3$$

$$t = kw^3$$

$$1728 = k \times 6^3$$

$$1728 = k \times 216 \div 216$$

$$8 = k$$

$$t = 8w^3$$

$$t = 8 \times (4.5)^3$$

$$= 729$$

eg The surface area of a cube varies directly with the square of the length of the cube's edge.

a) A cube of edge length 5.5cm has a surface area of 181.5cm². Find the constant of variation.

$$SA \propto L^2$$

$$SA = kL^2$$

$$181.5 = k \times (5.5)^2$$

$$181.5 = k \times 30.25$$

$$k = 6$$

b) Hence calculate the surface area of a cube with an edge length of 7.2cm.

$$SA = 6 \times L^2$$

$$= 6 \times 7.2^2$$

$$= 311.04 \text{ cm}^2$$

Practise using this site:

http://www.algebra-lab.org/lessons/lesson.aspx?file=Algebra_LinearEqDirectVariation.xml

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